Would petal-testing work in the Wimmera?

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Sclerotinia stem rot (sometimes known as white mould) is an important disease of many crops around the world. On canola it can cause substantial losses, but a number of fungicides (mostly benzimidazoles and dicarboxamides) have been used in different countries for control. To date, sclerotinia has not been a major problem on canola in the Wimmera, but in adjacent areas it does cause losses. Furthermore, it may become more important in the Wimmera in wet years because of the increased cultivation of broad-leaved crops. All broad-leaved crops are susceptible to *Sclerotinia sclerotiorum*, the fungus pathogen that causes stem rot.

Even in parts of the world where sclerotinia on canola is common, it is a difficult disease to work with. Disease incidence varies not only from year to year according to the weather, but also from field to field in years when the weather is conducive. Thus, blanket recommendations to spray fungicides on all canola crops in an area will result in unnecessary applications and wasted money.

A key question in disease management is whether or not it is economically justified to spray a fungicide. For some diseases a signal to spray is the appearance of symptoms on a few plants or leaves because this indicates a risk of further spread during the growing season. However, with sclerotinia on canola (plus a few other diseases), the decision is more difficult because you cannot wait until symptoms are visible. By then it is too late to spray.

Sclerotinia is different from most foliar diseases because there is only a single infection cycle in the growing season. In other words, the disease does not progressively increase as the crop grows. Thus, spray decisions have to be based on risk signals other than early symptoms. These signals might be environmental factors, like rainfall; host plant factors, like crop growth stage; or pathogen factors, such as previous occurrence of the disease in the area, or observation of some structure of the pathogen in the field. Over the years several good systems of risk assessment for sclerotinia stem rot have been developed in different countries. In this article I will explain the background to, and nature of, one system that I developed with my graduate students at the University of Saskatchewan.

In most diseases caused by *Sclerotinia sclerotiorum* the infection of plants (and therefore potential losses) is highly dependent on what is called crop phenology, in other words the growth stage of plants in the crop. The disease cycle of sclerotinia on canola is shown in Figure 1. Plants that are infected exhibit bleaching and shredding of the stems. Inside infected stems, black cylindrical structures, about the size of mouse droppings, are produced by the pathogen. These are called sclerotia and many of them fall to the ground at harvest time, where they can survive for several years.

When the next crop is grown, and provided that the soil surface is moist for at least 7-10 days, these sclerotia may germinate and produce cup-like structures called apothecia, typically 5-15 mm in diameter. The apothecia in turn release infective spores (ascospores) into the air. Note that 7-10 days soil surface wetness is needed for sclerotia to germinate. This is the first way in which crop growth stage influences the disease cycle and infection: until the crop canopy has closed, the soil surface will usually not remain wet long enough after a rain for sclerotia to germinate. So germination will probably not occur until the canola starts bolting.

The second influence of crop growth stage on infection is related to the fact that the spores released by apothecia do not have enough energy reserves to germinate and directly infect green leaves and stems. Instead, infection depends on spores landing on petals and other flower parts, which are quite short-lived. When these structures die and fall into the crop canopy, the spores can colonize them and utilize nutrients they contain. This provides enough energy to infect a leaf or stem and eventually leads to the characteristic symptoms of bleaching and to formation of new sclerotia. However, the important point is that infection cannot occur until the crop is flowering!

Because (a) sclerotia will usually not germinate until bolting, and (b) infection cannot occur until flowering, to be effective fungicide applications must be made in a narrow window from early to mid-bloom. However, we also saw this as an advantage to exploit in disease risk assessment. We were able to show that the percentage of petals carrying spores of *Sclerotinia* in a canola crop has a broad relationship with the percentage of infected plants later on. Thus, by measuring the percentage of spore-infested petals, we could estimate disease risk on a crop-by-crop basis.

To cut a very long story short, we developed petal testing (for spore infestation) as a method of risk assessment over the period from 1983 to to 1990. We started out with all the work done by research personnel, then moved to using farmers as guinea pigs (Please excuse the expression) for one or more parts of the exercise. Development culminated in 1990 with kits being sent out to a group of about 50 farmers across western Canada, who completed the whole exercise by themselves, then sent their materials and results back to us to verify their accuracy. Based on satisfactory results in 1990 we commercialised petal testing in 1991.

Briefly, petal testing works as follows. At early bloom the farmer collects flowering shoots from several sample sites in the crop. These are then brought back to the house and, working in a clean environment, the farmer uses forceps to pick a set number of petals from the flowering shoots. The petals are placed on a nutrient medium in petri dishes provided in the kit, then the dishes are incubated at room temperature for 3.5-4 days. In that time various fungi will grow out from the petals on to the medium, but to read the results (i.e. determine the percentage of petals carrying spores of *Sclerotinia*) all that is necessary is to distinguish *Sclerotinia* from anything else that grows.

Instructions for doing the petal test are included in both a manual and a videotape that are part of the kit. The manual includes color photographs that help the user differentiate *Sclerotinia* from other fungi in the petri dishes. The final step in the manual is a chart which allows the user to

convert from a percentage of *Sclerotinia*-infested petals to a disease risk level.

The concept behind petal testing is very simple, ie. to predict the final step in the disease cycle (diseased plants) by measuring a step just beforehand (Fig. 1). However, practical use of the kit is not everyone's cup of tea. It requires time and manual dexterity to manipulate the petals, patience to wait 3.5-4 days for the results, and a certain level of technical skill to read the results. We discovered in our developmental work with farmers that it was a good idea to get other members of the family involved in some of the work! This was reflected in the final version of the videotape we produced. Notwithstanding these limitations, a modest number of farmers and agronomists do use these kits in western Canada to help make fungicide decisions. As mentioned above, there are other methods of risk assessment for sclerotinia stem rot, but none that are based as much on information specific to the particular field.

Would petal testing work in the Wimmera? Perhaps, but at least two factors need to be looked at carefully first. First, the flowering period is longer in the Wimmera than in western Canada, where we grow spring-sown canola and flowering occurs during our warmest month. A longer flowering period means a longer period when infection may occur. Disease risk might need to be assessed two or three times by repeated tests during the flowering period, especially if the weather changed, but fungicide applications could be timed or split accordingly.

The second potential problem needing assessment is interference by the well-known fungus pathogen *Botrytis*. *Botrytis* is the only fungus that is hard to differentiate from *Sclerotinia* after 3-4 days' growth on a nutrient medium. This is no surprise, as it is a close relative of *Sclerotinia* and has a similar growth rate and early growth pattern. Although *Botrytis* is a known pathogen of canola, for reasons that are still unclear, spores of *Botrytis* are relatively uncommon on canola petals in western Canada. Thus, errors made by confusing the two fungi when reading test results will make little difference to the perceived risk level. However, I know partly from personal experience that in Europe and Scandinavia high levels of *Botrytis* spores are common on canola petals. Consequently, research scientists there have found it difficult to obtain accurate estimates of percent petal infestation with *Sclerotinia* after 4 days' growth.

Would the same situation apply in the Wimmera or elsewhere in Australia? Given that flowering in canola there coincides with the time that lentil and faba bean crops become infested with *Botrytis*, unfortunately the answer is probably yes. However, it would be worthwhile trying the test out, as it is an inexpensive way to avoid unnecessary fungicide applications.

Figure1: Sclerotinia disease cycle.